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TECHNICAL NOTE

RECIPROCITY TESTING
OF
KODAK FILM TYPE SO-289
MULTISPECTRAL INFRARED AERIAL FILM

Prepared Under
Contract NAS 9-11500
Task Order HT-114

Prepared By
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Photoscientist

August 1975

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Lyndon B. Johnson Space Center
Houston, Texas 77058



National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas

(NASA-CR-144427) RECIPROCITY TESTING OF
KODAK FILM TYPE SO-289 MULTISPECTRAL
INFRARED AERIAL FILM (Technicolor Graphic
Services, Inc.) 33 p HC \$3.75 CSCL 14F

G3/35
DacLas
40064

N75-3142C



RECIPROCITY TESTING
OF
KODAK FILM TYPE SO-289
MULTISPECTRAL INFRARED AERIAL FILM

This Report has been reviewed
and is approved.

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SUMMARY

Kodak multispectral infrared aerial film type SO-289 was tested for reciprocity characteristics because of the variance between the I-B sensitometer exposure times (8 seconds and 4 seconds) and the camera exposure time (1/500 second) used on ASTP project MA-007, Stratospheric Aerosol Measurement.

Test exposures were made on the flight emulsion using a Mead Star System sensitometer, the films were processed to ASTP control standards, the resulting densities read and reciprocity data calculated. It was found that less exposure was required to produce a typical density (1.3) at 1/500 second exposure time than at an 8 second exposure time. This exposure factor was 2.8.

PROBLEM

Kodak Type SO-289, Multispectral infrared aerial film, emulsion 4-1 was used on Apollo Soyuz Test Project experiment MA-007, Stratospheric Aerosol Measurement. The exposure times used to make the inflight camera exposures (1/500 second) and the I-B sensitometer calibration exposures (4 and 8 seconds) varied because of intensity of the illuminants. The camera photographed the sun while the sensitometer used an incandescent lamp filtered to 5500°K. Both instruments recorded images on film through a spacecraft window and a Wratten 87C filter.

The effects of reciprocity law failure result in unequal densities produced on a photographic film even though the combination of exposure intensity and exposure time were constant. The photographic image formed is dependent upon the intensity and time with the imaging being more efficient (less energy required to produce a given density) at some times and intensities. In this test the variance between sensitometer and camera exposure times was large enough to suspect significant reciprocity effects.

PROCEDURE

A series of exposures from 1/1024 second to 8 seconds were made on the SO-289-4-1 test film, the film was processed to the ASTP standard, the sensitometric results were plotted and the reciprocity results were calculated. The experiment was replicated.

Exposures

The Photographic Technology Division (PTD) I-B sensitometer is limited to 1/100 second as the shortest exposure time therefore alternate exposure methods were sought. The EG&G Mark VI sensitometer is capable of exposures from 1/100 to 1/10,000 second leaving no PTD capability for exposure times from 1/500 to 8 seconds on a single exposing instrument.

A Mead Star System I-B sensitometer which has the capability for exposing at times from 1/1024 second to long time exposures was available within NASA facilities at the Kennedy Space Center (KSC). This system was used for exposing the SO-289 test strips with calibrated 21-step sensitometric exposures.

The illuminant in the Star sensitometer was 3200°K filtered to 5500°K. Intensity was adjusted as follows using Inconel neutral density filters:

| <u>Times</u> | <u>Neutral Density</u> |
|----------------------|------------------------|
| 1/1024 to 1/128 sec. | None |
| 1/64 to 1/8 sec. | 1.0ND |
| 1/4 to 8 sec. | 2.0ND |

It was not possible to use the Wratten 87C filter because the reduction in exposure intensity would not permit the use of short exposure times.

Star System data for no neutral density filter is shown in Table 1.

TABLE 1

STAR SYSTEM EXPOSURE DATA

| | | | |
|---------------|--------------------------------------|-------------------|-----------------------------------|
| Illuminance | 0.31079507E 00 MC | LOG I | 9.49247360-10 |
| Radiant Power | 0.12435257E 00 μ Watts/ Sq-Cm | Log Radiant Power | 9.09465408-10 μ Watt Sq-Cm |

| TIME (sec) | EXPOSURE (mcs) | LOG EXP. (mcs) | RADIANT EXPOSURE | LOG RAD. EXPOSURE |
|---------------|-------------------|-------------------|---------------------|----------------------|
| 0.2000 E 01 | 0.6216 E 00 | 9.7935-10 | 0.2487 E 01 | 10.3957-10 |
| 0.1000 E 01 | 0.3108 E 00 | 9.4925-10 | 0.1244 E 01 | 10.0947-10 |
| 0.5008 E 00 | 0.1556 E 00 | 9.1921-10 | 0.6228 E 00 | 9.7943-10 |
| 0.2504 E 00 | 0.7782 E-01 | 8.8911-10 | 0.3114 E 00 | 9.4933-10 |
| 0.1252 E 00 | 0.3891 E-01 | 8.5901-10 | 0.1557 E 00 | 9.1923-10 |
| 0.6260 E-01 | 0.1946 E-01 | 8.2890-10 | 0.7784 E-01 | 8.8912-10 |
| 0.3130 E-01 | 0.9728 E-02 | 7.9880-10 | 0.3892 E-01 | 8.5902-10 |
| 0.1560 E-01 | 0.4848 E-02 | 7.6856-10 | 0.1940 E-01 | 8.2878-10 |
| 0.7802 E-02 | 0.2424 E-02 | 7.3846-10 | 0.9699 E-02 | 7.9867-10 |
| 0.3901 E-02 | 0.1212 E-02 | 7.0835-10 | 0.4850 E-02 | 7.6857-10 |
| 0.1951 E-02 | 0.6061 E-03 | 6.7825-10 | 0.2425 E-02 | 7.3847-10 |
| 0.9750 E-03 | 0.3030 E-03 | 6.4815-10 | 0.1212 E-02 | 7.0837-10 |

A cross calibration was performed using the PTD I-B sensitometer exposing the SO289 at a series of exposure times both with the light source filtered to 5500°K and with an 87C added. Only a relatively narrow band of exposure times could be achieved because of machine limitations.

Films were delivered to and from KSC using care to minimize environmental effects.

Processing

The test strips were processed in an 11CM Versamat at 85°F. in MX641 chemistry using the ASTP standard for SO289 as a control. The control was achieved prior to processing the initial complete set of exposed strips and verified prior to processing the second set. The control strip curve is included here as Figure 1 and speed was within 0.02 log E of ASTP rolls IR01 and IR02 certification curves.

Plotting

The densities from each Star system exposure were read using the MacBeth TD504 densitometer and the data was plotted.

FILM S0-289 EMULSION 4-1

EXPOSURE DATA

SENSITOMETER I-B

ILLUMINANT 2850

TIME 8

FILTER 5500°K+SCW+87C

11C-M
MX-641
15

MacBeth
TD504
3
Visual

1
85

CHEMICAL
ANALYSIS

SP GR

pH

TA

TRP

KB_r

| | |
|----|------|
| 21 | 2.10 |
| 20 | 1.08 |
| 19 | 2.07 |
| 18 | 2.04 |
| 17 | 2.00 |
| 16 | 1.92 |
| 15 | 1.81 |
| 14 | 1.67 |
| 13 | 1.48 |
| 12 | 1.27 |
| 11 | 1.05 |
| 10 | .85 |
| 9 | .65 |
| 8 | .49 |
| 7 | .37 |
| 6 | .29 |
| 5 | .25 |
| 4 | .22 |
| 3 | .21 |
| 2 | .20 |
| 1 | .20 |

Technicolor

ABSOLUTE
LOG E
AT R.L.E. 0

mcs ergs/cm

FIGURE 1. S0-289 Certification

Relative log Exposures required to produce densities of 1.3, 1.0 and 0.7 were determined from the density versus log exposure curves for each strip; this exposure was added to the neutral density factor used for each exposure to obtain a relative log exposure. The relative log exposure necessary to produce each of the three densities were plotted against \log_{10} time for each exposure to achieve the reciprocity curves.

RESULTS

The reciprocity data obtained for SO-289 is attached as Table 2 and the associated curves are attached as Figure 2.

Density versus log exposure data for one set of exposures is included as Attachment A.

Reciprocity data for the SO-289 tested using the PTD I-B sensitometer is included as Attachment B.

CONCLUSIONS

Reciprocity law failure is apparent with SO-289 film as demonstrated by the data in Table 2 and by reciprocity curves. Exposing factors, normalized to 1/1024 second exposure, required to produce equal densities of 1.3 are listed in Table 2. At the extremes of exposure these are as great as 2.87.

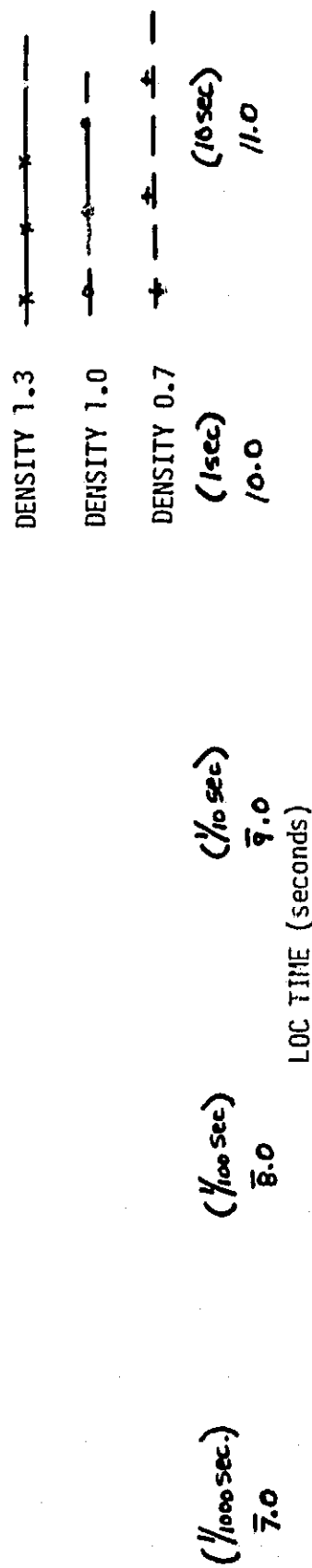
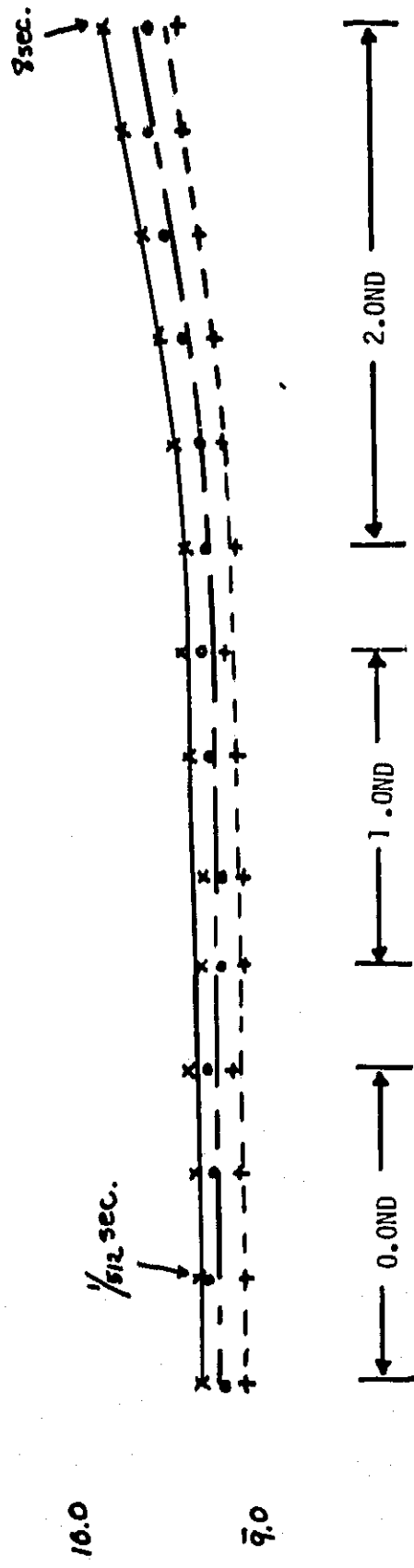
The most efficient exposure times; i.e. that exposure requiring the least energy to produce a given density, appear to be at 1/32 second or faster.

TABLE 2
RECIPROCITY DATA

| Exposure Time (sec) | Relative Log ₁₀ 1.3 | Exposure at Density 1.0 | 0.7 | Exposure Factor (1/1024 = Normal) |
|------------------------|-----------------------------------|----------------------------|-------|--------------------------------------|
| 1/1024 | 1.3 | 1.19 | 1.04 | 1.0 |
| 1/512 | 1.31 | 1.29 | 1.06 | 1.02 |
| 1/256 | 1.322 | 1.212 | 1.072 | 1.05 |
| 1/128 | 1.363 | 1.243 | 1.103 | 1.16 |
| 1/64 | 1.29 | 1.174 | 1.034 | 0.98 |
| 1/32 | 1.28 | 1.17 | 1.03 | 0.96 |
| 1/16 | 1.336 | 1.216 | 1.086 | 1.09 |
| 1/8 | 1.397 | 1.277 | 1.127 | 1.25 |
| 1/4 | 1.328 | 1.218 | 1.068 | 1.07 |
| 1/2 | 1.40 | 1.27 | 1.12 | 1.26 |
| 1 | 1.47 | 1.33 | 1.12 | 1.48 |
| 2 | 1.552 | 1.43 | 1.27 | 1.79 |
| 4 | 1.65 | 1.51 | 1.34 | 2.24 |
| 8 | 1.758 | 1.608 | 1.448 | 2.87 |

S0-289-4...]
 Reciprocity Data
 Star Sensitometer
 5500°K III.

FIGURE 2

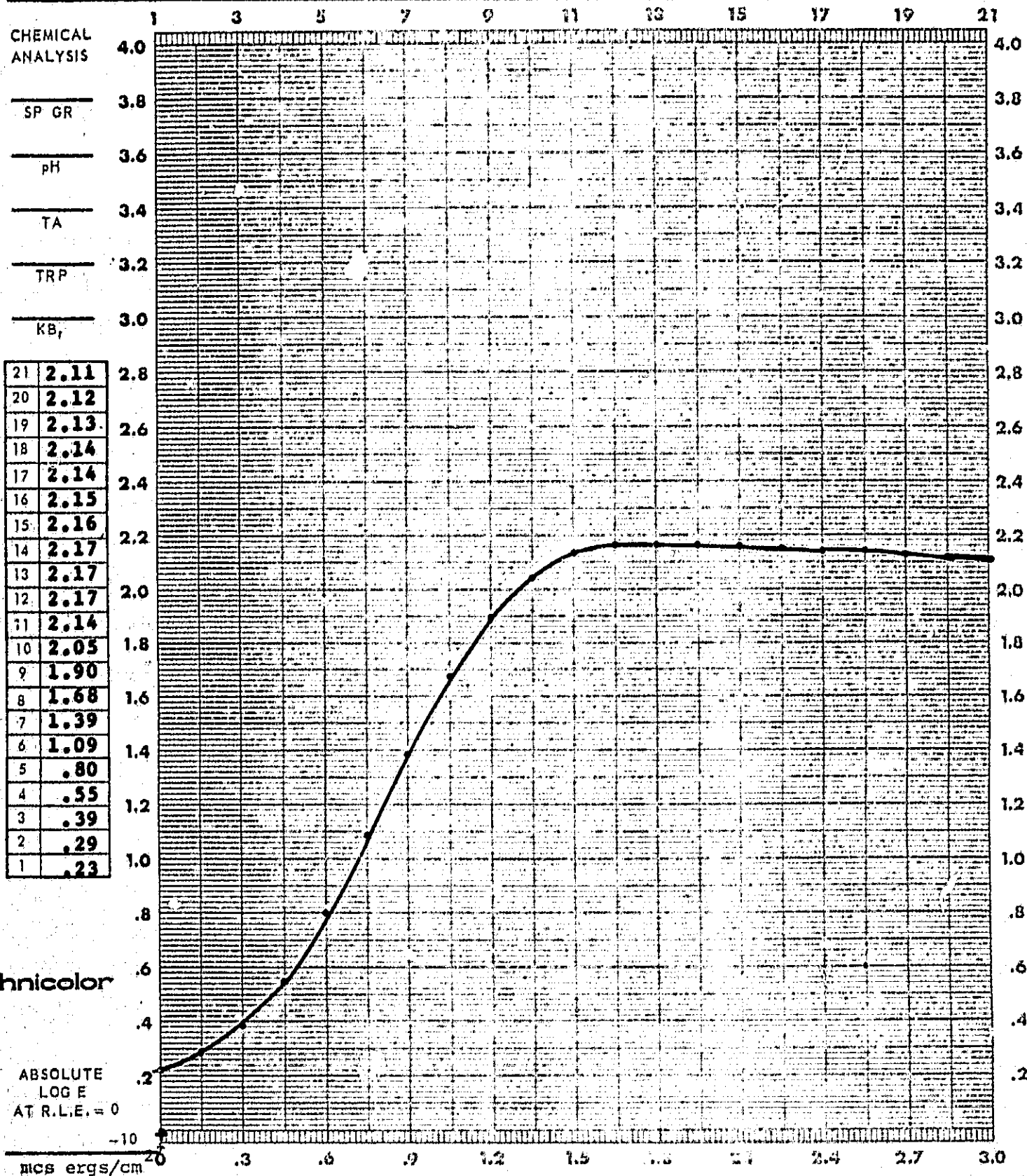


ATTACHMENT A

Density versus log exposure data for the Star sensitometer exposed strips varying in exposure times from 1/1024 to 8 seconds are included here.

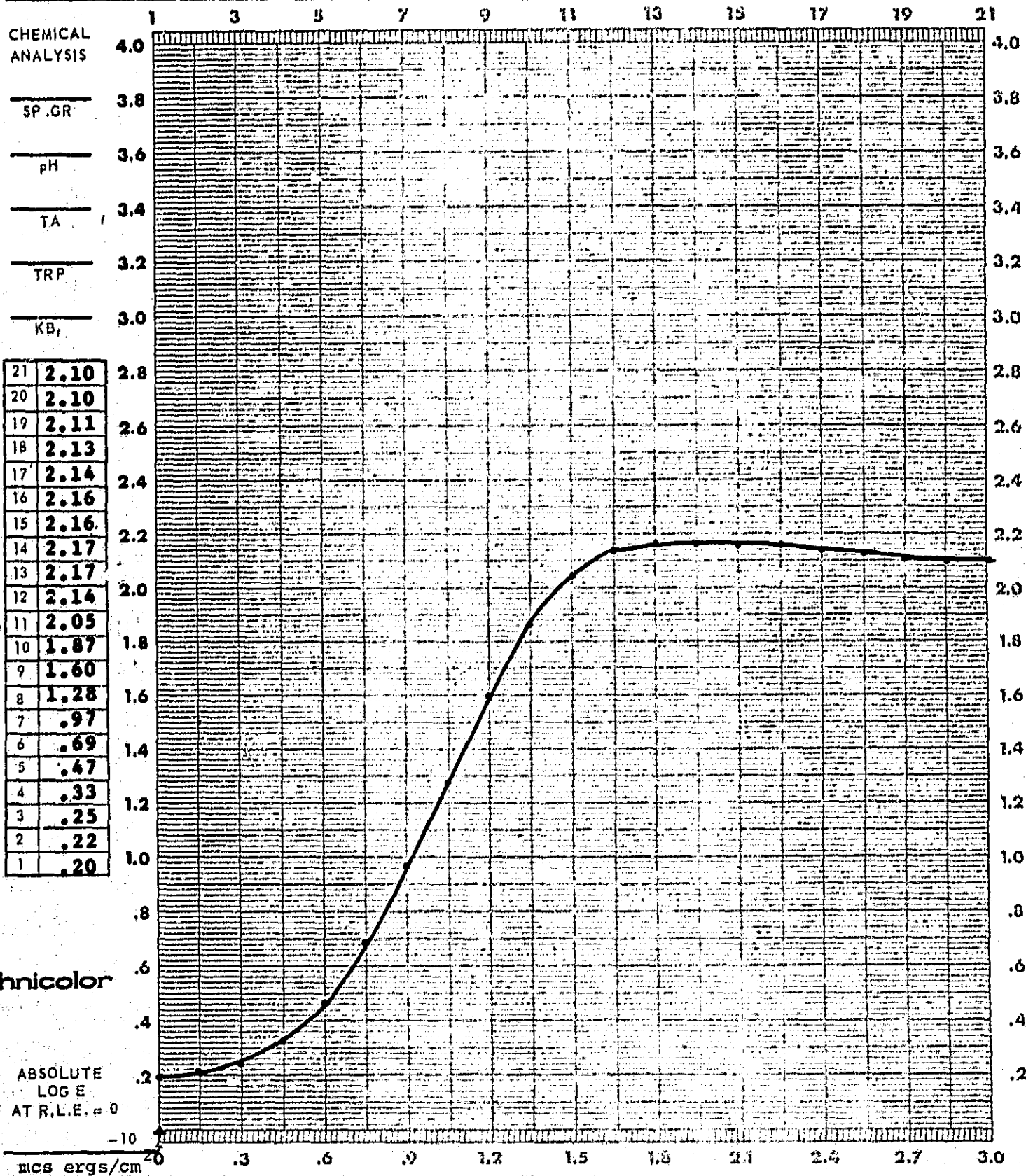
FILM S0-289 EMULSION # 4-1 MFG EXPIRATION DATE

| EXPOSURE DATA | | PROCESSING DATA | | DENSITOMETRY | |
|---------------|---------------------|-----------------|----------------------|---------------|-----------------------------|
| SENSITOMETER | <u>Star</u> | PROCESSOR | <u>11C-M</u> | INSTRUMENT | <u>MacBeth</u> |
| ILLUMINANT | <u>3200</u> K | CHEMISTRY | <u>MX-641</u> | TYPE | <u>TD504</u> |
| TIME | <u>8</u> SEC. | SPEED | <u>1</u> / <u>15</u> | APERTURE SIZE | <u>3</u> MM |
| FILTER | <u>5500°K+2.0ND</u> | TEMP | <u>85</u> °F | FILTER | <u>Visual</u> |
| | | | | SPEED () | <u> </u> |
| | | | | D-MAX | <u> </u> |
| | | | | GAMMA | <u> </u> |
| | | | | BASE + FOG | <u> </u> |



DATE 8 Aug 75 CONTROL # _____ TASK _____ PREPARED BY _____FILM S0-289 EMULSION # 4-1 MFG _____ EXPIRATION DATE _____

| EXPOSURE DATA | | PROCESSING DATA | | DENSITOMETRY | |
|---------------|---------------------|-----------------|------------------------------|---------------|------------------|
| SENSITOMETER | <u>Star</u> | PROCESSOR | <u>11C-M</u> | INSTRUMENT | <u>MacBeth</u> |
| ILLUMINANT | <u>3200</u> K | CHEMISTRY | <u>MX-641</u> | TYPE | <u>TD504</u> |
| TIME | <u>4</u> SEC. | SPEED | <u>1</u> TANKS <u>15</u> MIN | APERTURE SIZE | <u>3</u> MM |
| FILTER | <u>5500°K+2,0ND</u> | TEMP °F | <u>85</u> TIME | FILTER | <u>Visual</u> |
| | | | | | SPEED () _____ |
| | | | | | D-MAX _____ |
| | | | | | GAMMA _____ |
| | | | | | BASE + FOG _____ |



FILM 50-289 EMULSION # 4-1 EXPOSURE DATE

| EXPOSURE DATA | | PROCESS | | DENSITOMETRY | |
|---------------|--------------|-----------|--------|--------------|---------|
| SENSITOMETER | Star | PROCESSOR | 11C-M | DEVELOPER | MacBeth |
| ILLUMINANT | 3200 K | CHEMIST | MX-641 | TEMP | TD504 |
| TIME | 2 | DEVELOP | 1 | TEMP | 3 |
| FILTER | 5500°K+2.0ND | TEMP | 85 | VIEWER | Visual |

CHEMICAL
ANALYSIS

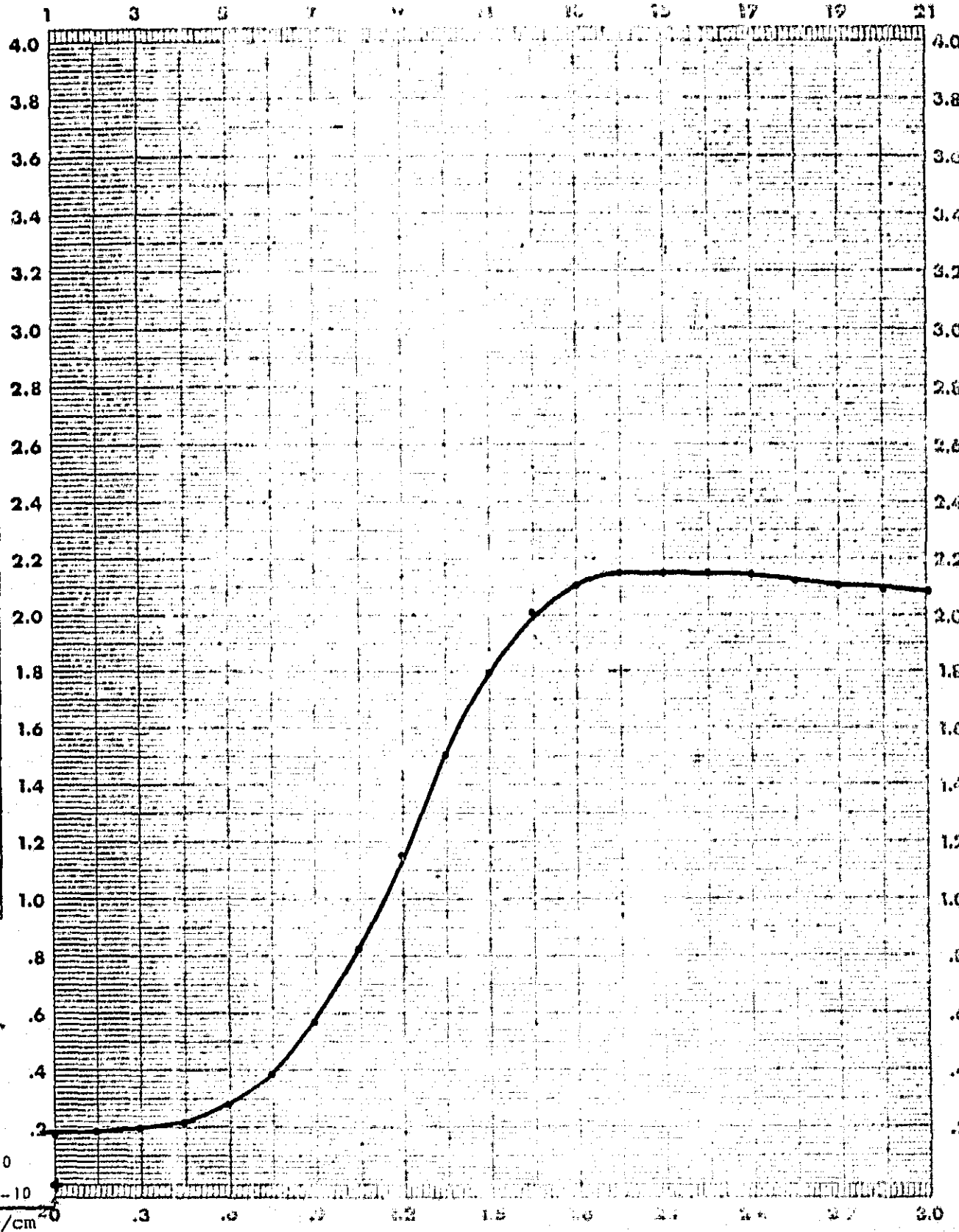
SP GR
pH
TA
TRP
KB_r

| | |
|----|------|
| 21 | 2.08 |
| 20 | 2.09 |
| 19 | 2.10 |
| 18 | 2.12 |
| 17 | 2.14 |
| 16 | 2.15 |
| 15 | 2.15 |
| 14 | 2.15 |
| 13 | 2.11 |
| 12 | 2.01 |
| 11 | 1.80 |
| 10 | 1.51 |
| 9 | 1.16 |
| 8 | .83 |
| 7 | .57 |
| 6 | .39 |
| 5 | .28 |
| 4 | .22 |
| 3 | .20 |
| 2 | .19 |
| 1 | .18 |

Technicolor

ABSOLUTE
LOG E
AT R.L.E. = 0

mcscrgs/cm²



| | | | | | | | |
|---------------|--------------|---------|--------|---------|---------|-------|---|
| EXPOSURE DATA | | PROCESS | | REAGENT | | SPEED | |
| SENSITOMETER | Star | PROCESS | T1C-M | REAGENT | MacBeth | SPEED | 1 |
| ILLUMINANT | 3200 K | CHEMIST | MX-641 | REAGENT | TD5041 | SPEED | 1 |
| TIME | 1 | SPEED | 1 | REAGENT | 3 | SPEED | 1 |
| FILTER | 5500°K+2.QND | TEMP | 85 | REAGENT | Visual | SPEED | 1 |

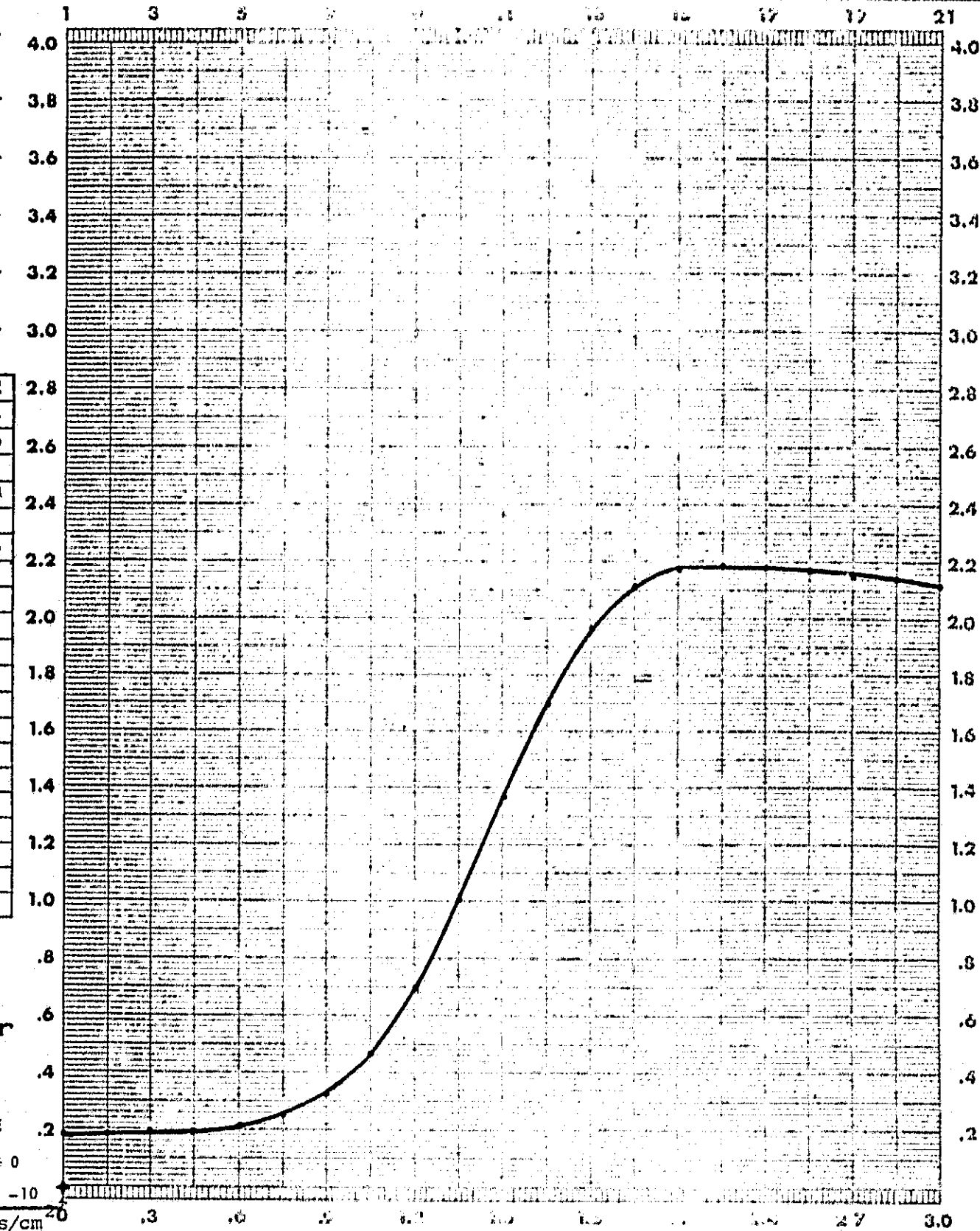
CHEMICAL ANALYSIS

SP GR
pH
TA
TRP
KB_r

| | |
|----|------|
| 21 | 2.12 |
| 20 | 2.14 |
| 19 | 2.15 |
| 18 | 2.17 |
| 17 | 2.18 |
| 16 | 2.19 |
| 15 | 2.18 |
| 14 | 2.12 |
| 13 | 1.97 |
| 12 | 1.70 |
| 11 | 1.37 |
| 10 | 1.01 |
| 9 | .70 |
| 8 | .47 |
| 7 | .33 |
| 6 | .26 |
| 5 | .22 |
| 4 | .20 |
| 3 | .20 |
| 2 | .19 |
| 1 | .19 |

Technicolor

ABSOLUTE LOG E
AT R.L.E. = 0



mcs ergs/cm²

FILM S0-289 EMULSION # 4-1 MFG _____ EXPIRATION DATE _____

| EXPOSURE DATA | | PROCESSING DATA | | DENSITOMETRY | |
|----------------------------|--|-------------------------|------------|---------------------------|------------------|
| SENSITOMETER <u>Star</u> | | PROCESSOR <u>11C-M</u> | | INSTRUMENT <u>MacBeth</u> | SPEED () _____ |
| ILLUMINANT <u>3200</u> K | | CHEMISTRY <u>MX-641</u> | | TYPE <u>TD504</u> | D-MA _____ |
| TIME <u>1/2</u> SEC. | | SPEED <u>1</u> | <u>15</u> | APERTURE SIZE <u>3</u> | GAMMA _____ |
| FILTER <u>5500°K+2.0ND</u> | | TEMP <u>85</u> | TIME _____ | FILTER <u>Visual</u> | BASE + FOG _____ |

CHEMICAL ANALYSIS

SP GR

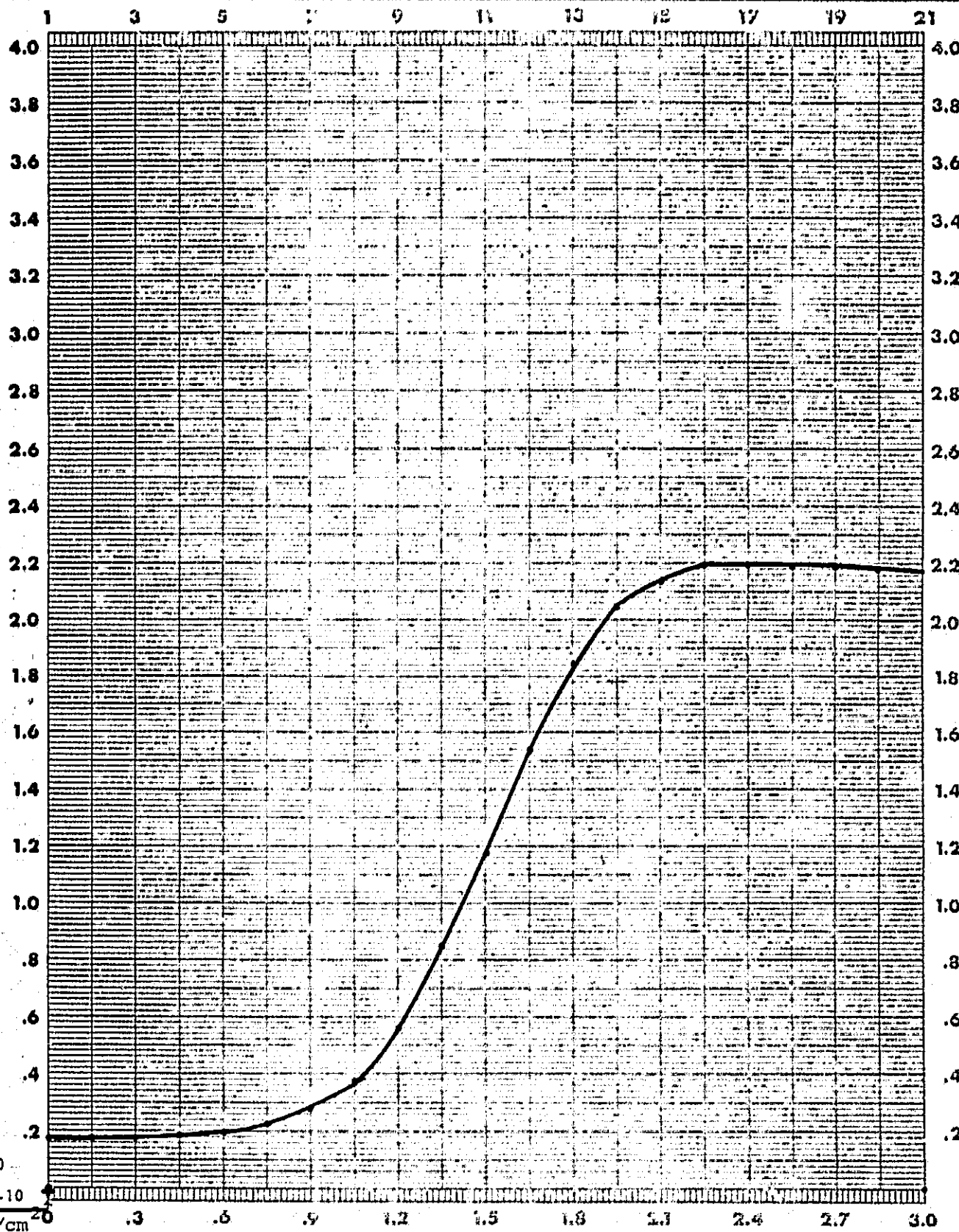
pH

TA

TRP

KB_r

| | |
|----|------|
| 21 | .00 |
| 20 | 2.18 |
| 19 | 2.19 |
| 18 | 2.19 |
| 17 | 2.20 |
| 16 | 2.20 |
| 15 | 2.14 |
| 14 | 2.05 |
| 13 | 1.85 |
| 12 | 1.54 |
| 11 | 1.18 |
| 10 | .85 |
| 9 | .56 |
| 8 | .38 |
| 7 | .28 |
| 6 | .23 |
| 5 | .20 |
| 4 | .19 |
| 3 | .18 |
| 2 | .18 |
| 1 | .18 |



FILM S0-289 EMULSION # 4-1

| EXPOSURE DATA | | FILM DATA | | PROCESSING DATA | |
|---------------|---------------------|-----------|----|-----------------|--|
| SENSITOMETER | <u>Star</u> | 11C-M | | MacBeth | |
| ILLUMINANT | <u>3200</u> | MX-641 | | TD504 | |
| TIME | <u>1/4</u> | 1 | 15 | 3 | |
| FILTER | <u>5500°K+2.0ND</u> | 85 | | Visual | |

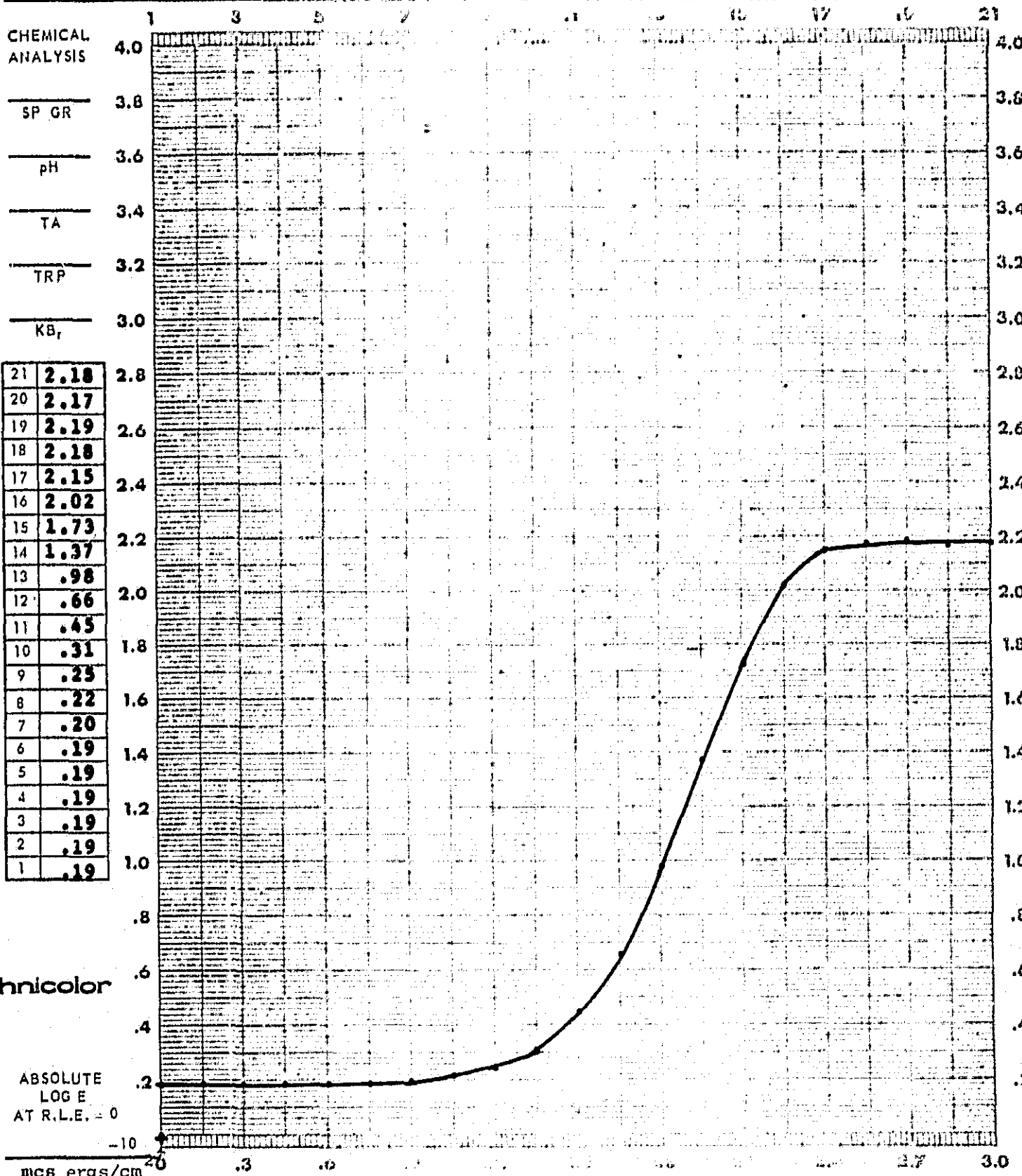
CHEMICAL ANALYSIS

SP GR _____
pH _____
TA _____
TRP _____
KB_r _____

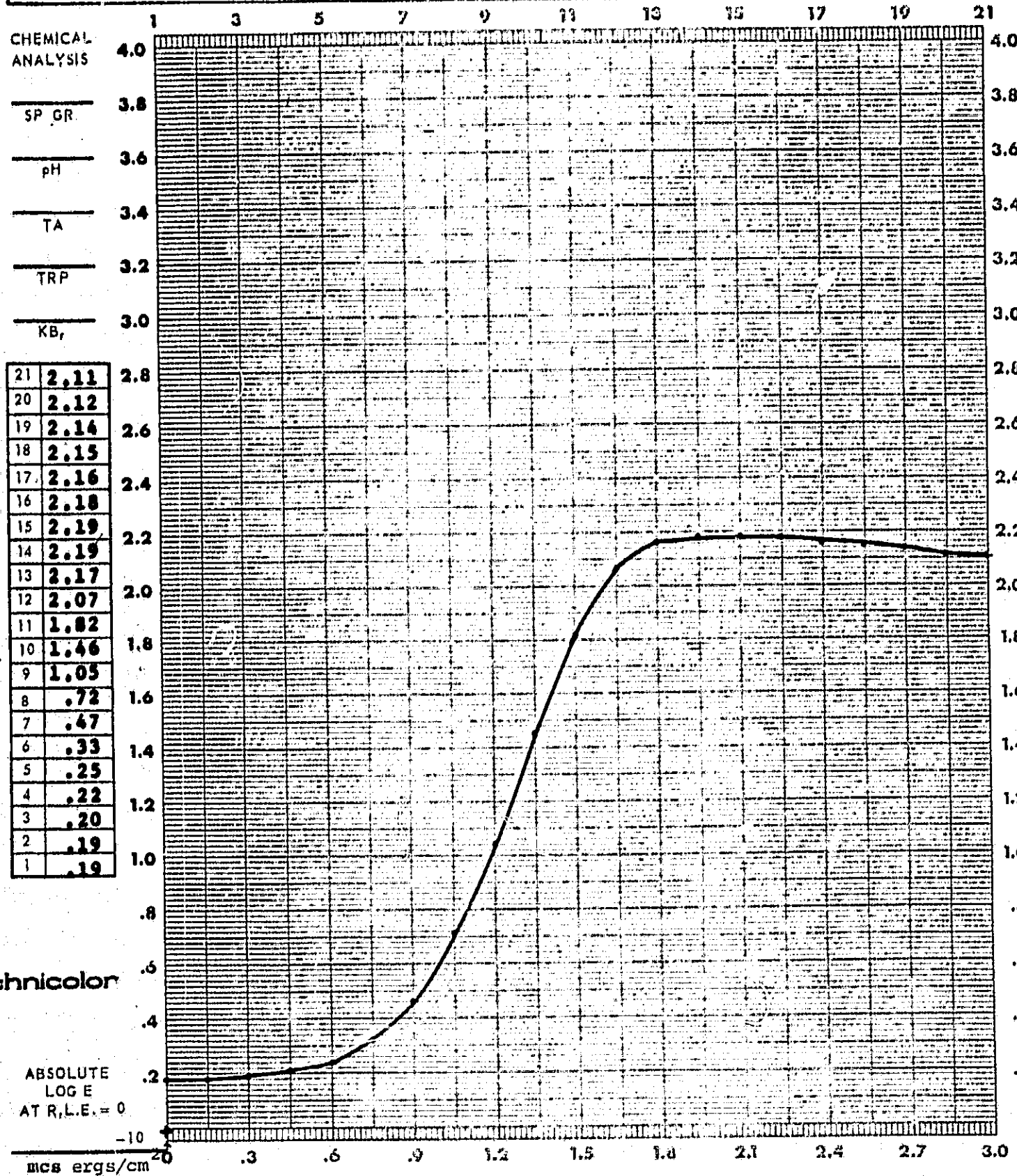
| | |
|----|------|
| 21 | 2.18 |
| 20 | 2.17 |
| 19 | 2.19 |
| 18 | 2.18 |
| 17 | 2.15 |
| 16 | 2.02 |
| 15 | 1.73 |
| 14 | 1.37 |
| 13 | .98 |
| 12 | .66 |
| 11 | .45 |
| 10 | .31 |
| 9 | .25 |
| 8 | .22 |
| 7 | .20 |
| 6 | .19 |
| 5 | .19 |
| 4 | .19 |
| 3 | .19 |
| 2 | .19 |
| 1 | .19 |

Technicolor

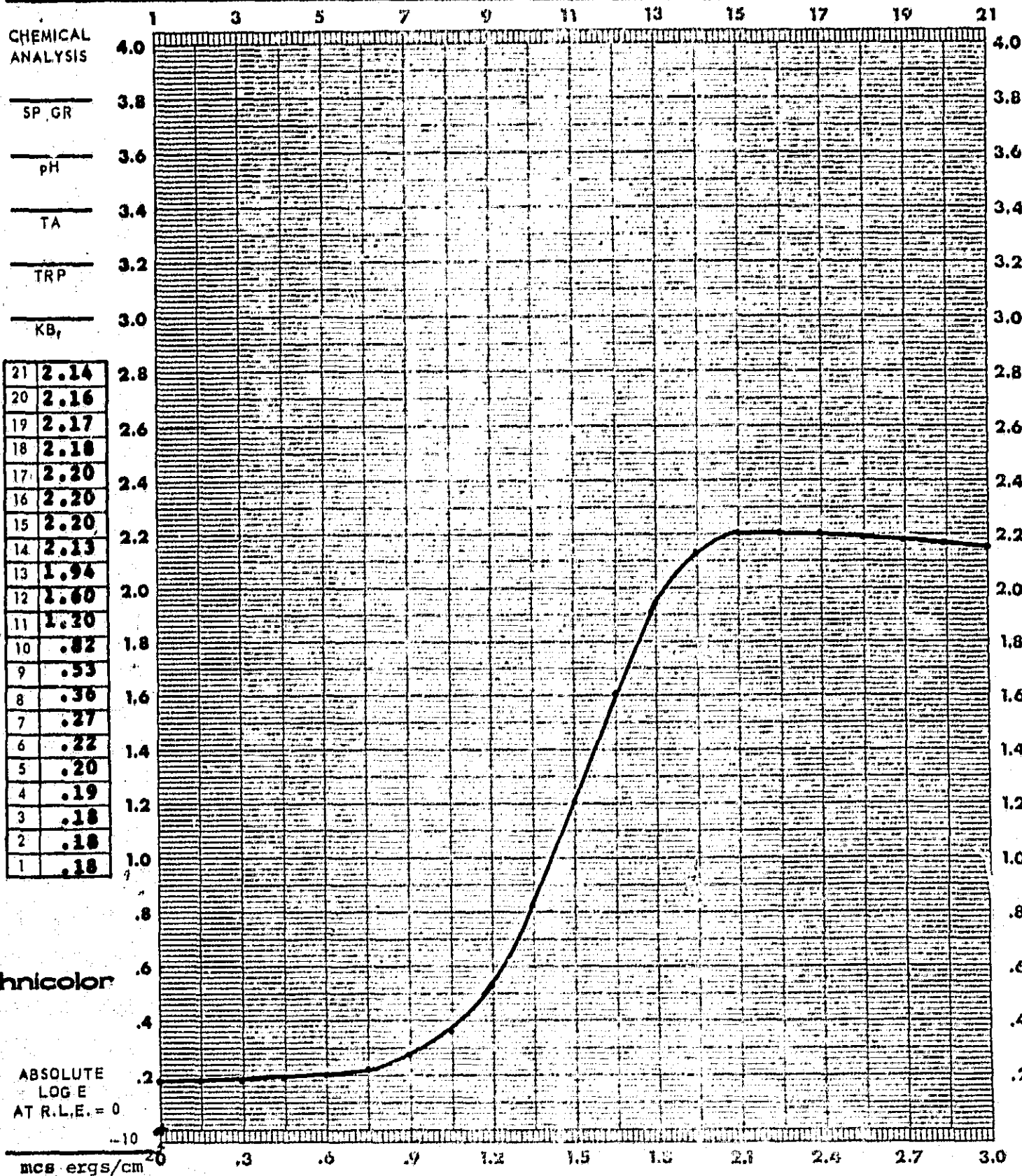
ABSOLUTE LOG E
AT R.L.E. = 0



| EXPOSURE DATA | | PROCESSING DATA | | DENSITOMETRY | |
|---------------|---------------------|-----------------|--------------------|---------------|----------------|
| SENSITOMETER | <u>Star</u> | PROCESSOR | <u>11C-M</u> | INSTRUMENT | <u>MacBeth</u> |
| ILLUMINANT | <u>3200</u> K | CHEMISTRY | <u>MX-641</u> | TYPE | <u>TD504</u> |
| TIME | <u>1/8</u> SEC. | SPEED | <u>1</u> <u>15</u> | APERTURE SIZE | <u>3</u> |
| FILTER | <u>5500°K+1.0ND</u> | TEMP | <u>85</u> | FILTER | <u>Visual</u> |
| | | | | | SPEED () |
| | | | | | D-MAX |
| | | | | | GAMMA |
| | | | | | BASE + FOG |



| EXPOSURE DATA | | PROCESSING DATA | | DENSITOMETRY | |
|---------------|---------------------|-----------------|------------------------------|---------------|------------------|
| SENSITOMETER | <u>Star</u> | PROCESSOR | <u>11C-M</u> | INSTRUMENT | <u>MacBeth</u> |
| ILLUMINANT | <u>3200 °K</u> | CHEMISTRY | <u>MX-641</u> | TYPE | <u>TD504</u> |
| TIME | <u>1/16</u> SEC. | SPEED | <u>1</u> TAKES <u>15</u> FPM | APERTURE SIZE | <u>3</u> MM |
| FILTER | <u>5500°K+1.0ND</u> | TEMP °F | <u>85</u> TIME _____ | FILTER | <u>Visual</u> |
| | | | | | SPEED () _____ |
| | | | | | D-MAX _____ |
| | | | | | GAMMA _____ |
| | | | | | BASE + FOG _____ |



FILM SO-289 EMULSION # 4-1 EXPIRATION DATE

| EXPOSURE DATA | | PROCESsing DATA | | DENSITOMETRY | |
|---------------|---------------------|-----------------|---------------|---------------|--------------|
| SENSITOMETER | <u>Star</u> | PROCESSOR | <u>11C-M</u> | MacBeth | <u>TD504</u> |
| ILLUMINANT | <u>3200</u> | CHEMICAL | <u>MX-641</u> | | |
| TIME | <u>1/32</u> | SPEED | <u>1</u> | <u>3</u> | |
| FILTER | <u>5500°K+1.0ND</u> | TEMP | <u>85</u> | <u>Visual</u> | |

CHEMICAL ANALYSIS

SP GR

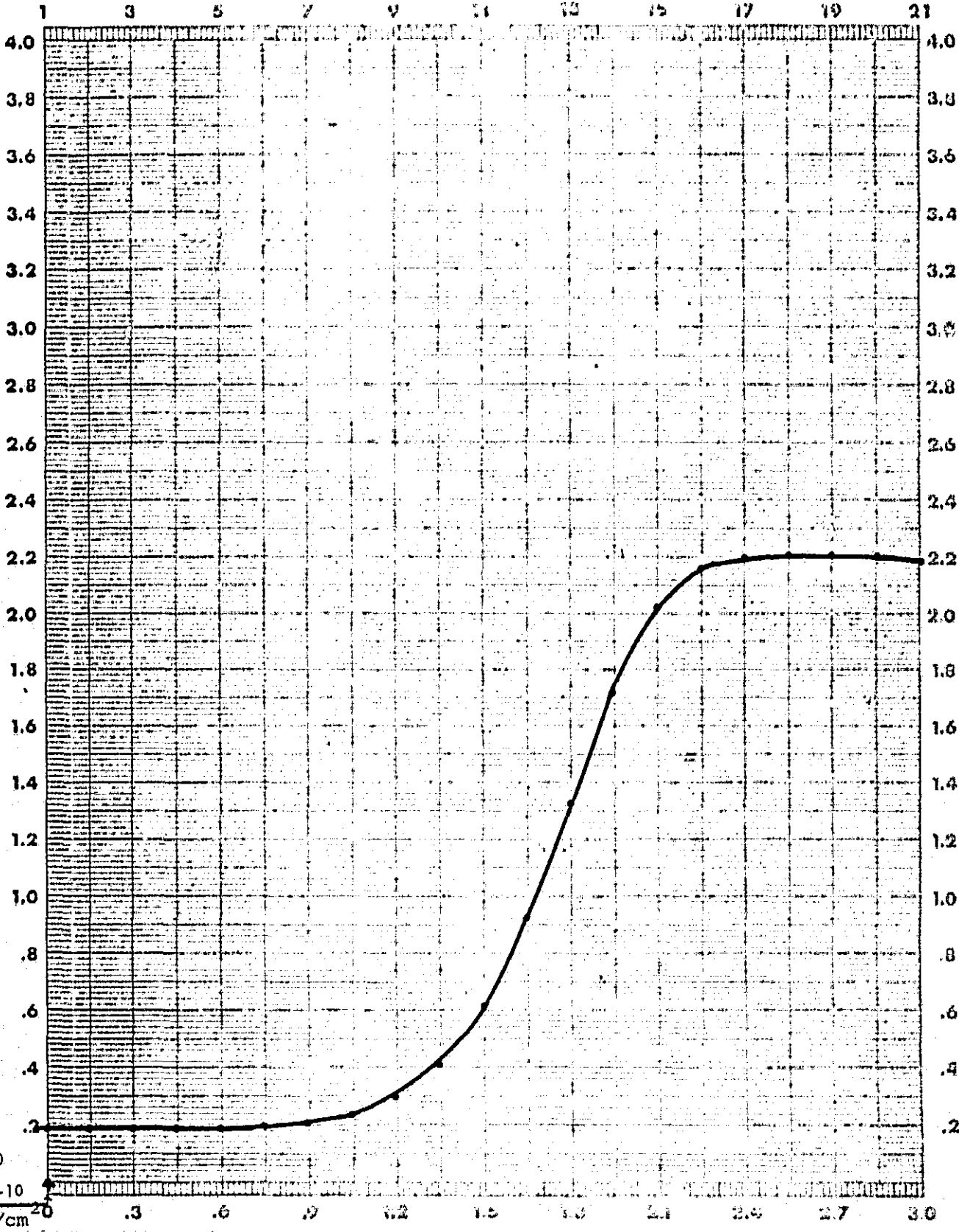
pH

TA

TRP

KB_r

| | |
|----|------|
| 21 | 2.18 |
| 20 | 2.20 |
| 19 | 2.21 |
| 18 | 2.21 |
| 17 | 2.20 |
| 16 | 2.16 |
| 15 | 2.02 |
| 14 | 1.72 |
| 13 | 1.33 |
| 12 | .93 |
| 11 | .62 |
| 10 | .41 |
| 9 | .30 |
| 8 | .24 |
| 7 | .21 |
| 6 | .20 |
| 5 | .19 |
| 4 | .19 |
| 3 | .19 |
| 2 | .19 |
| 1 | .19 |



Technicolor

FILM SO-289 EMULSION # 4-1 _____ EXPIRATION DATE _____

| EXPOSURE DATA | | PROCESSING | | DENSITOMETRY | |
|---------------|---------------------|------------|---------------|--------------|----------------|
| SENSITOMETER | <u>Star</u> | PROCESSOR | <u>11C-M</u> | DENSITOMETER | <u>MacBeth</u> |
| ILLUMINANT | <u>3200</u> | CHEMIST | <u>MX-641</u> | SPOT | <u>TD504</u> |
| TIME | <u>1/64</u> | SPEED | <u>15</u> | APERTURE | <u>3</u> |
| FILTER | <u>5500°K+1.CND</u> | TEMP | <u>85</u> | VIEW | <u>Visual</u> |

CHEMICAL ANALYSIS

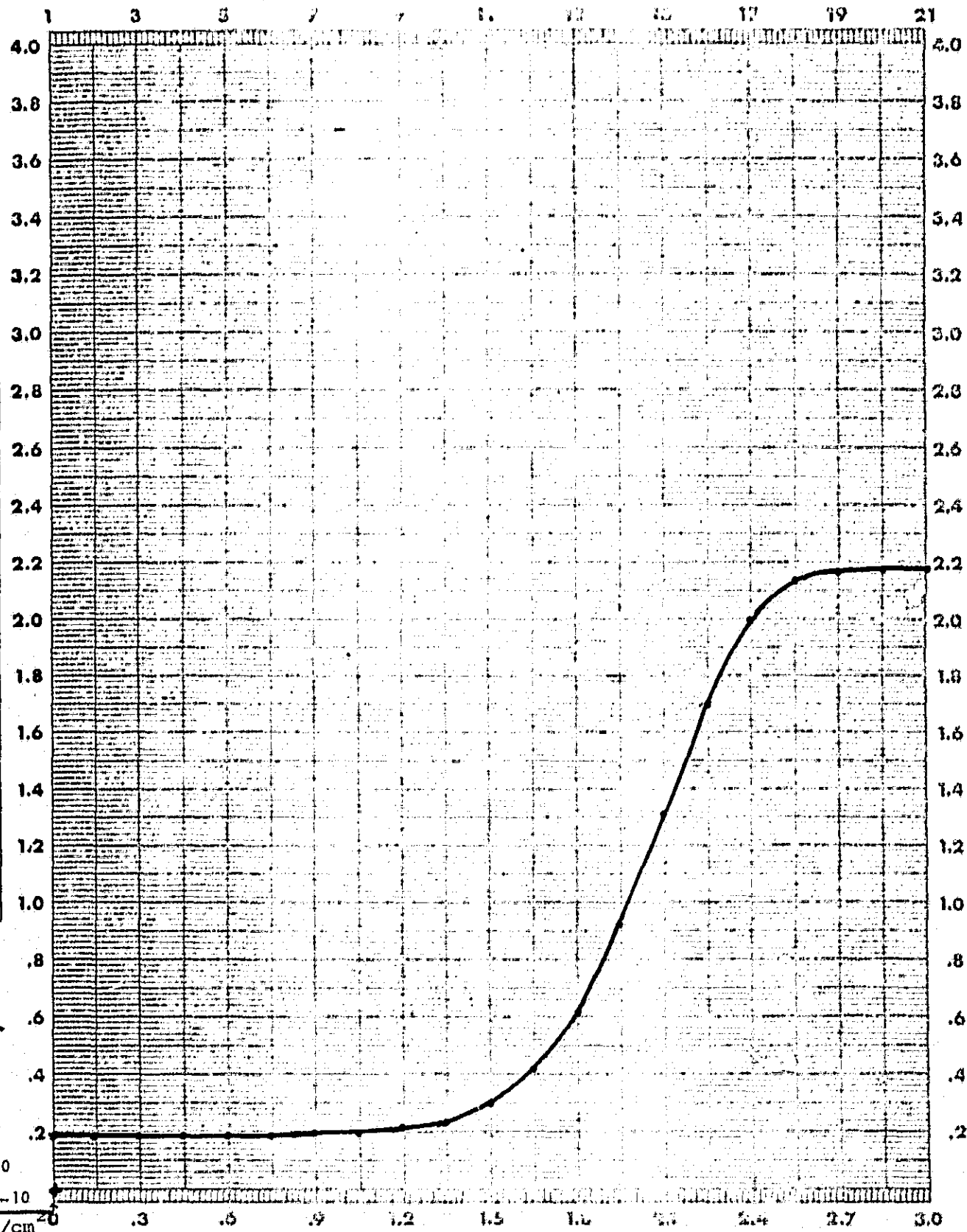
SP GR
pH
TA
TRP
KB_r

| | |
|----|------|
| 21 | 2.18 |
| 20 | 2.18 |
| 19 | 2.17 |
| 18 | 2.14 |
| 17 | 2.00 |
| 16 | 1.71 |
| 15 | 1.32 |
| 14 | .93 |
| 13 | .62 |
| 12 | .42 |
| 11 | .30 |
| 10 | .24 |
| 9 | .22 |
| 8 | .20 |
| 7 | .20 |
| 6 | .19 |
| 5 | .19 |
| 4 | .19 |
| 3 | .19 |
| 2 | .19 |
| 1 | .19 |

Technicolor

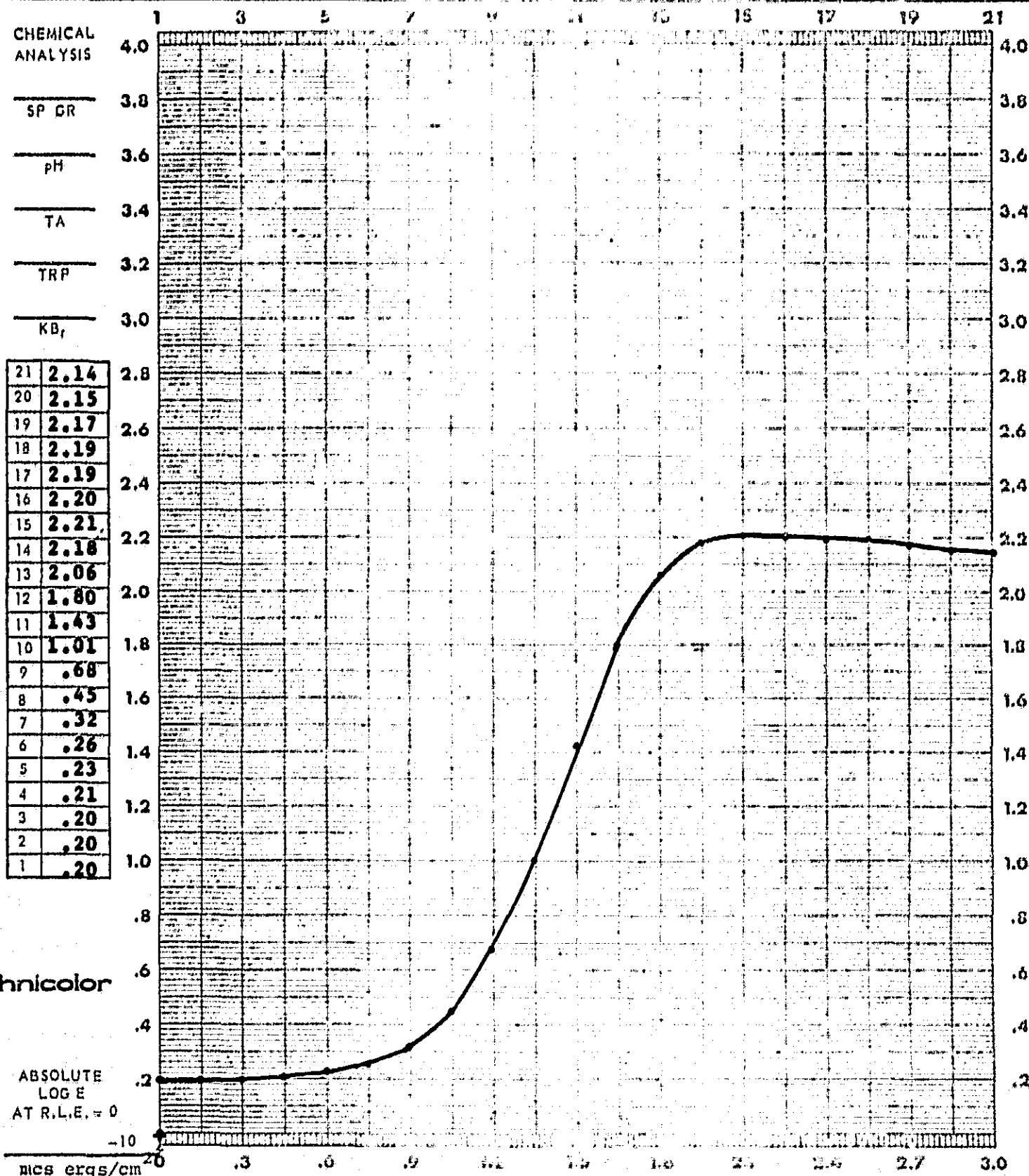
ABSOLUTE LOG E
A₁ R.L.E. = 0

mcs ergs/cm²



FILM S0-289 EMULSION # 4-1 EXPIRATION DATE _____

| EXPOSURE DATA | | PROCEDURE | | DENSITOMETRY | |
|---------------|---------------|-------------|---------------|--------------|----------------|
| SENSITOMETER | <u>Star</u> | PROCEDURE | <u>11C-M</u> | INSTRUMENT | <u>MacBeth</u> |
| ILLUMINANT | <u>3200</u> K | SENSITIVITY | <u>MX-641</u> | | <u>TD504</u> |
| TIME | <u>1/128</u> | SPEED | <u>15</u> | TEMPERATURE | <u>3</u> |
| FILTER | <u>5500°K</u> | TEMP | <u>85</u> | VIEWER | <u>Visual</u> |



FILM S0-289 EMULSION 4-1

EXPOSURE DATA

SENSITOMETER Star
ILLUMINANT 3200
TIME 1/256
FILTER 5500°K

11C-M
MX-641
15

MacBeth
TD504
3
Visual

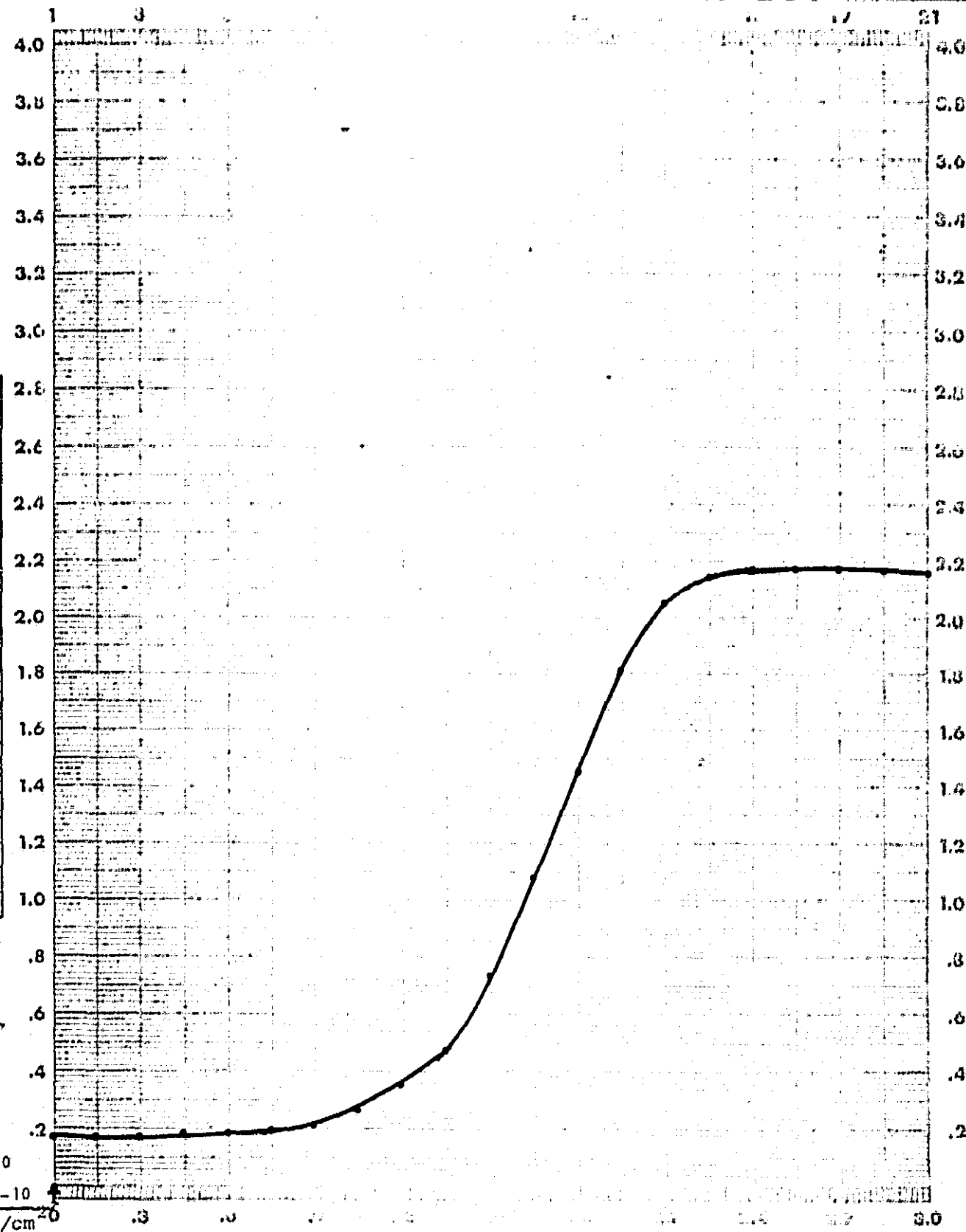
CHEMICAL
ANALYSIS

SP G₁
pH
TA
TRP
KB₁

| | |
|----|------|
| 21 | 2.16 |
| 20 | 2.17 |
| 19 | 2.18 |
| 18 | 2.18 |
| 17 | 2.18 |
| 16 | 2.15 |
| 15 | 2.06 |
| 14 | 1.82 |
| 13 | 1.46 |
| 12 | 1.08 |
| 11 | .74 |
| 10 | .48 |
| 9 | .36 |
| 8 | .27 |
| 7 | .22 |
| 6 | .20 |
| 5 | .19 |
| 4 | .19 |
| 3 | .18 |
| 2 | .18 |
| 1 | .18 |

Technicolor

ABSOLUTE
LOG E
AT R.L.E. = 0



EXPOSURE DATA

SENSITOMETER Star
ILLUMINANT 3200
TIME 1/512
FILTER 5500°K

11C-M
MX-641
15

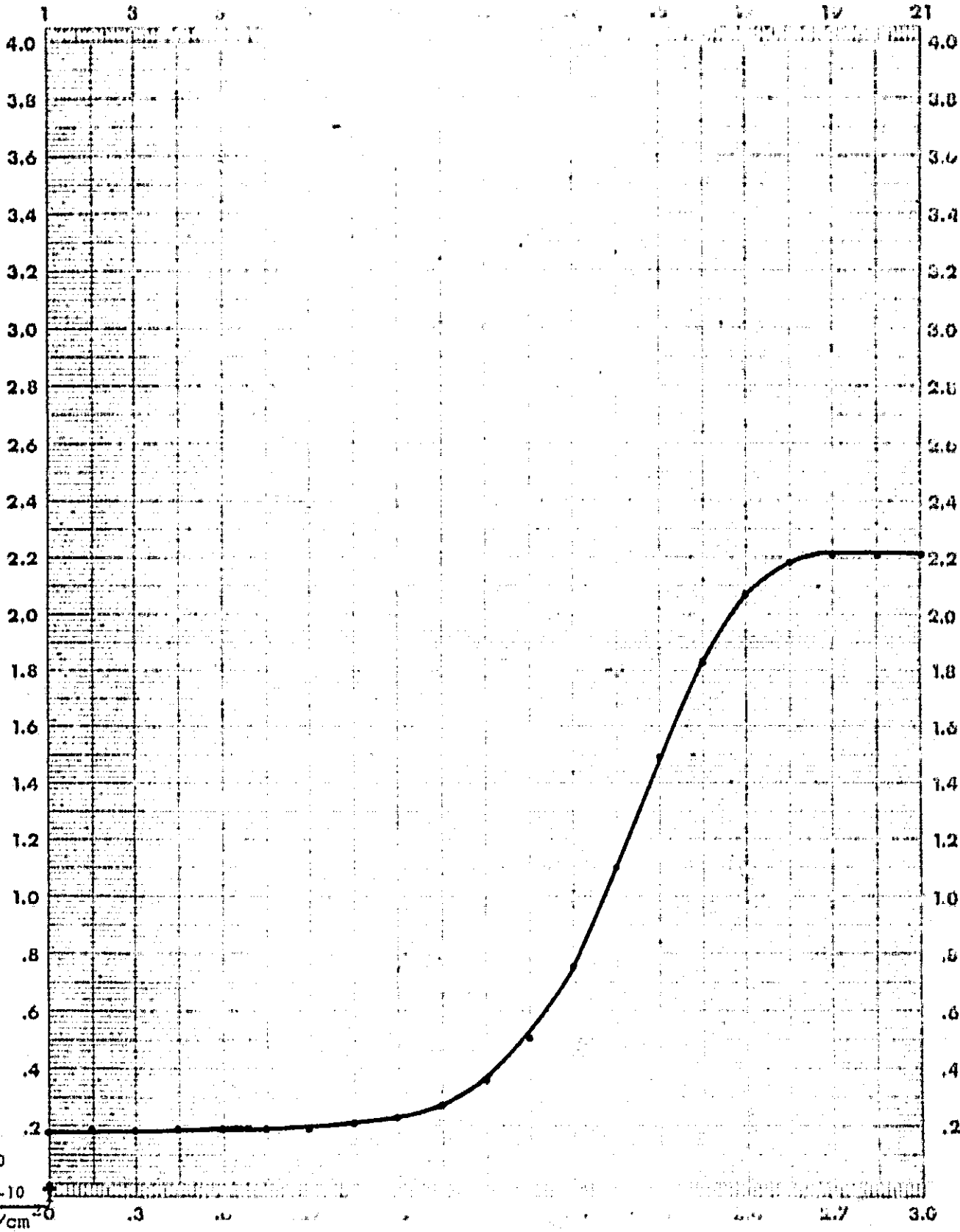
MacBeth
TD504
3
Visual

85

CHEMICAL ANALYSIS

SP GR
pH
TA
TRP
KB_f

| | |
|----|------|
| 21 | 2.22 |
| 20 | 2.22 |
| 19 | 2.22 |
| 18 | 2.19 |
| 17 | 2.08 |
| 16 | 1.84 |
| 15 | 1.50 |
| 14 | 1.11 |
| 13 | .77 |
| 12 | .52 |
| 11 | .37 |
| 10 | .28 |
| 9 | .24 |
| 8 | .22 |
| 7 | .20 |
| 6 | .20 |
| 5 | .20 |
| 4 | .20 |
| 3 | .19 |
| 2 | .20 |
| 1 | .19 |



FILM SO-289 EMULSION # 4-1 EXPIRATION DATE

| EXPOSURE DATA | | PROCESSING | | DENSITOMETRY | |
|---------------|---------------|-------------|---------------|---------------|-------------------|
| SENSITOMETER | <u>Star</u> | PROCESSOR | <u>11C-M</u> | MacBeth | SPEED () |
| ILLUMINANT | <u>3200</u> | CHEMISTRY | <u>MX-641</u> | <u>TD504</u> | D. MAX |
| TIME | <u>1/1024</u> | TEMPERATURE | <u>1</u> | <u>15</u> | GAMMA |
| FILTER | <u>5500°K</u> | TEMPERATURE | <u>85</u> | <u>Visual</u> | CASE # <u>FOU</u> |

CHEMICAL ANALYSIS

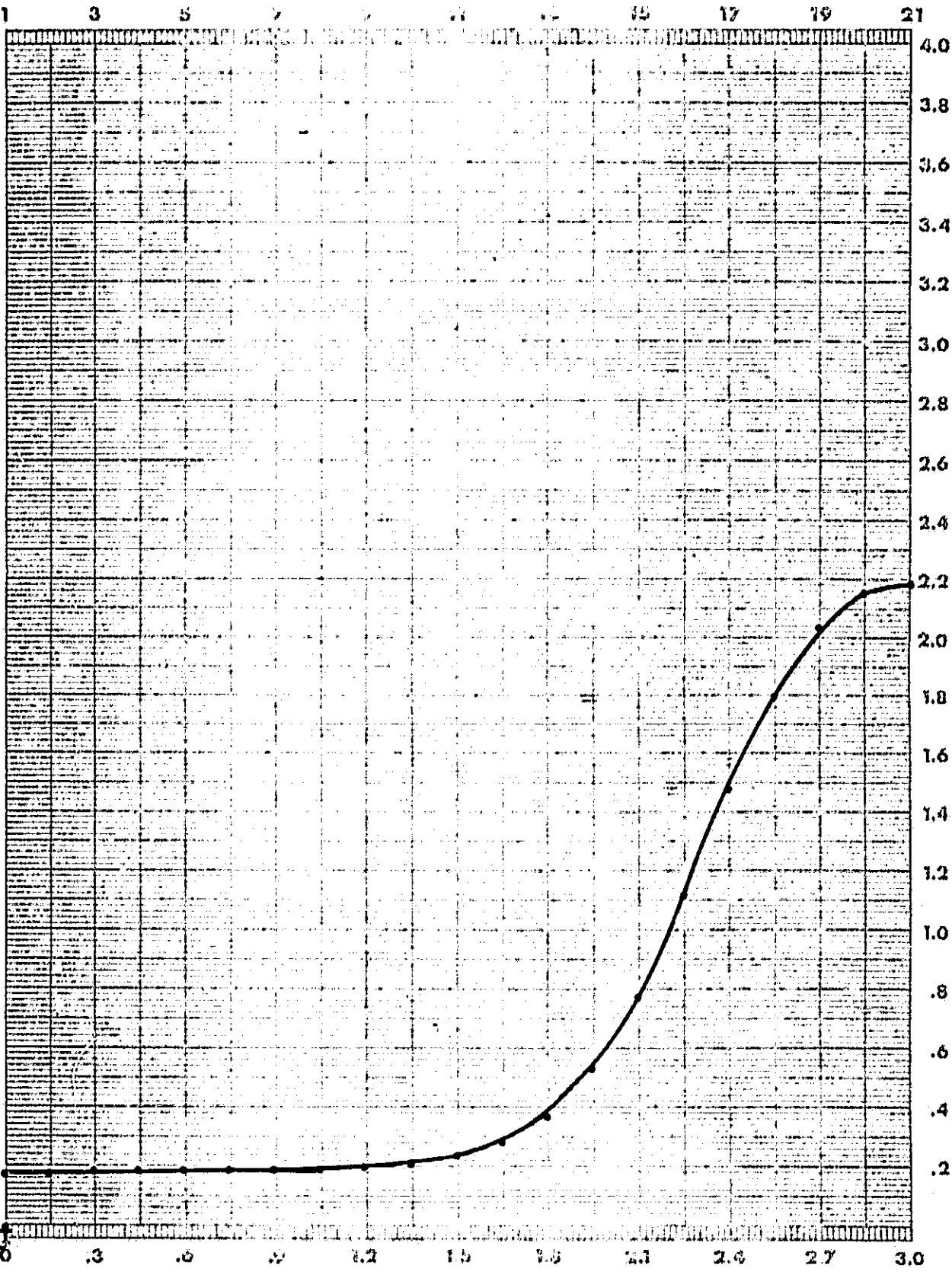
SP GR
pH
TA
TRP
K₂Cr₂O₇

| | |
|----|------|
| 21 | 2.20 |
| 20 | 2.17 |
| 19 | 2.05 |
| 18 | 1.81 |
| 17 | 1.49 |
| 16 | 1.13 |
| 15 | .79 |
| 14 | .54 |
| 13 | .38 |
| 12 | .29 |
| 11 | .25 |
| 10 | .22 |
| 9 | .21 |
| 8 | .20 |
| 7 | .20 |
| 6 | .20 |
| 5 | .20 |
| 4 | .20 |
| 3 | .20 |
| 2 | .19 |
| 1 | .19 |

Technicolor

ABSOLUTE
LOG E
AT R.L.E. = 0

mcs ergs/cm²⁰



ATTACHMENT B

Reciprocity data for the times obtainable with the PTD I-B sensitometer with three illuminants are attached here.

Illuminants appear to have little influence on reciprocity data.

RELATIVE LOG EXPOSURE

I-B SENSITOMETER ILLUMINANT

| Exposure Time | Density | 2850°K | 5500°K | 87C |
|------------------|---------|--------|--------|-------|
| 8 | 1.3 | 9.37 | 10.303 | 12.66 |
| 8 | 1.0 | 9.22 | 10.153 | 12.47 |
| 8 | 0.7 | 9.08 | 9.983 | 12.26 |
| 4 | 1.3 | 9.30 | 10.21 | 12.56 |
| 4 | 1.0 | 9.15 | 10.06 | 12.40 |
| 4 | 0.7 | 8.96 | 9.91 | 12.20 |
| 2 | 1.3 | ----- | ----- | 12.49 |
| 2 | 1.0 | ----- | ----- | 12.30 |
| 2 | 0.7 | ----- | ----- | 12.11 |
| 1 | 1.3 | 9.13 | 10.07 | 12.44 |
| 1 | 1.0 | 8.99 | 9.93 | 12.26 |
| 1 | 0.7 | 8.81 | 9.73 | 12.05 |
| 1/2 | 1.3 | 9.07 | 10.02 | 12.38 |
| 1/2 | 1.0 | 8.93 | 9.87 | 12.20 |
| 1/2 | 0.7 | 8.77 | 9.72 | 12.02 |
| 1/5 | 1.3 | ----- | ----- | ----- |
| 1/5 | 1.0 | ----- | ----- | 12.07 |
| 1/5 | 0.7 | ----- | ----- | 11.97 |
| 1/10 | 1.3 | 9.01 | 9.92 | ----- |
| 1/10 | 1.0 | 8.87 | 9.79 | ----- |
| 1/10 | 0.7 | 8.72 | 9.64 | ----- |
| 1/25 | 1.3 | 8.96 | ----- | ----- |
| 1/25 | 1.0 | 8.81 | ----- | ----- |
| 1/25 | 0.7 | 8.66 | ----- | ----- |
| 1/50 | 1.3 | 8.94 | 9.86 | ----- |
| 1/50 | 1.0 | 8.81 | 9.72 | ----- |
| 1/50 | 0.7 | 8.64 | 9.59 | ----- |

50-289-4-1
Reciprocity Data
I-B Sensitometer
2850°K III.

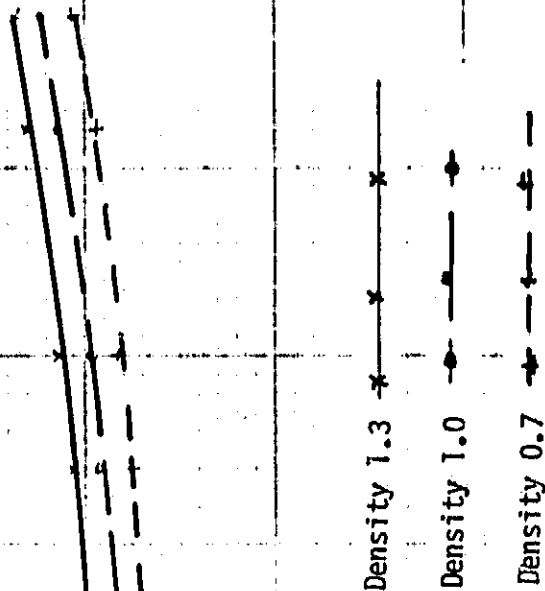
10.0

9.0

8.0

7.0

Relative Log Exposure



($\frac{1}{1000}$ sec.)
7.0

($\frac{1}{100}$ sec.)
8.0

($\frac{1}{10}$ sec.)
9.0

(1 sec.)
10.0

(10 sec.)
11.0

Log Time (second)

50-289-4-1
Reciprocity Data
I-B Sensitometer
5500°K + 87C Filter

13.0



11.0

10.0

Density 1.3

Density 1.0

Density 0.7

(1/100 sec.)

7.0

(1/10 sec.)

8.0

(1/10 sec.)

9.0

(1 sec.)

10.0

(10 sec.)

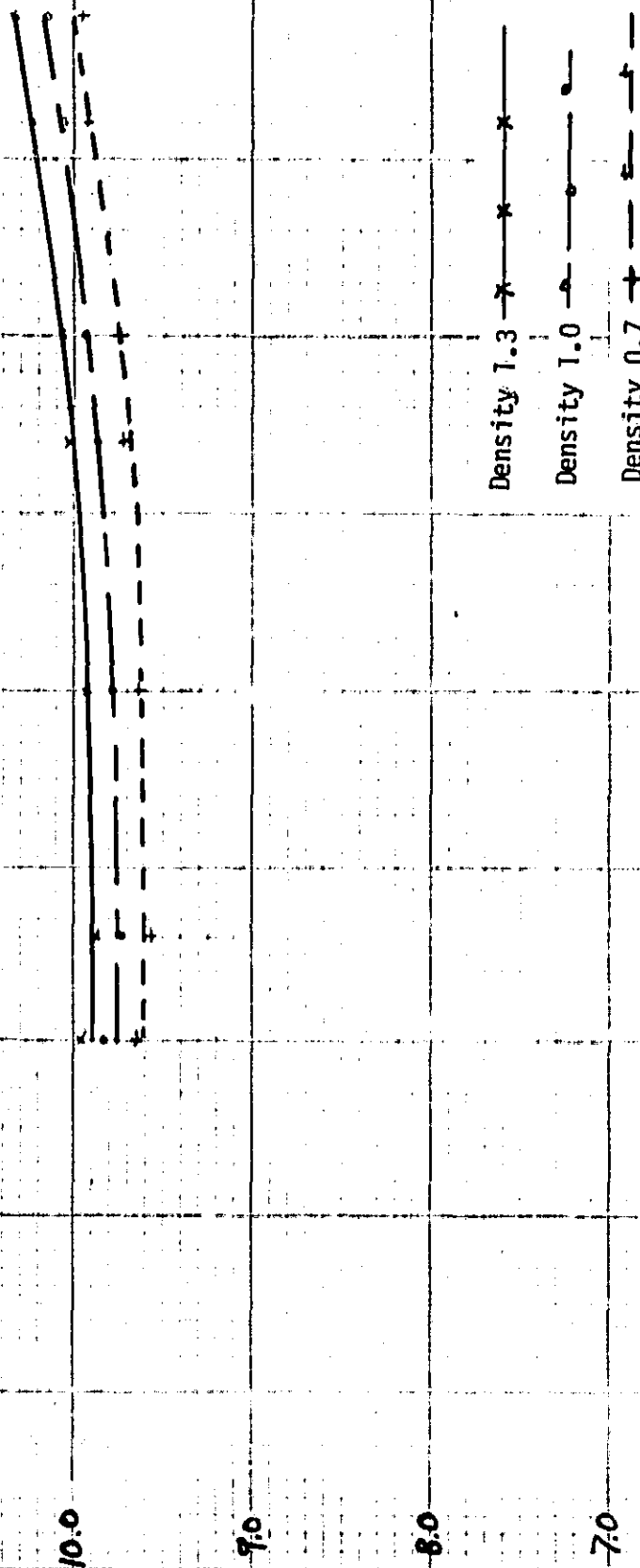
11.0

Log Time (second)

Relative Log Exposure

SO-289-4-1
Reciprocity Data
I-B Sensitometer
5500°K III.

Relative Log Exposure



Density 1.3 — x —
Density 1.0 — • —
Density 0.7 — + —

(1/1000 sec)
7.0

(1/100 sec)
8.0

(1/10 sec)
9.0

(1 sec)
10.0

(10 sec)
11.0

Log Time (second)